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TECHNICAL REPORT NO. 19

BRIDGE DECK PROTECTIVE SYSTEMS

PROJECT WORK PLAN

materials bureau technical services subdivision

75-4

BRIDGE DECK PROTECTIVE SYSTEMS

PROJECT WORK PLAN

April 23, 1975

DEVELOPMENT AND GENERAL ENGINEERING SECTION

MATERIALS BUREAU, N.Y.S.D.O.T.

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INTRODUCTION. The corrosion of reinforcing steel due to the penetration of de-icing salts has only recently been identified as a major contributing factor in the early deterioration of concrete bridge decks. National concern over the severity of the problem and the subsequent costs of repairing or replacing damaged decks prompted the Federal Highway Administration to institute National Experimental and Evaluation Programs (NEEP) No. 12, Bridge Deck Protective Systems and No. 16, Epoxy Coated Reinforcing Steel. Under these programs the States are encouraged to use experimental materials and techniques in their bridge deck construction, and to report the performance of these experimental features to FHWA.

In conjunction with NEEP Nos. 12 and 16, the N.Y.S. Department of Transportation has developed a program to evaluate available methods of delaying or preventing reinforcing steel corrosion in an effort to develop more durable and longer-lived concrete bridge decks. As part of this program the Development and General Engineering Section of the Materials Bureau has been assigned the responsibility of evaluating coated reinforcing steel, preformed sheet membranes and liquid membranes as bridge deck protective systems. This project work plan covering the Development and General Engineering Section's participation outlines the scope of the program, the methods and materials under evaluation, and the evaluation procedure.

SCOPE. The purpose of this project is to determine the performance of coated reinforcing steel, preformed sheet membranes and liquid membranes as bridge deck protective systems. This includes, but is not limited to methods of fabrication, methods of construction, cost and the long term ability to delay or prevent corrosion of the reinforcing steel.

The materials being investigated are all intended to prevent water and de-icing salts from reaching the reinforcing steel and thereby prevent corrosion of the steel. The difference between the reinforcing steel protective coatings and the membranes is that the coatings are applied directly to the steel before concrete placement. The membranes, both liquid and preformed sheet are applied to the concrete surface of the structural deck prior to placement of a wearing course. Obviously, the reinforcing steel coatings can only be used on a new bridge or when the entire deck of an existing bridge is to be replaced. The membranes may be used in new two-course construction, in the overlaying of an existing bridge deck, or in the replacement of an existing wearing course. It is not the intent of this program to select one optimum protective system to be implemented by the Department in all cases. As shown above, each of the system types has certain characteristics which might make it more useful in a particular location. It is hoped that our program in conjunction with NEEP Nos. 12 and 16 will develop sufficient information regarding the materials under investigation to allow the designer to choose the most effective protective system for a particular structure based on its cost, ease of construction, and the expected benefits.

The materials to be evaluated in this program are:

1. Galvanized reinforcing steel - standard reinforcing steel hot-dip galvanized after fabrication to provide an average zinc coating of 2.3 oz./sq.ft. on the reinforcing bars.

2. Epoxy coated reinforcing steel - standard reinforcing steel coated with an approved epoxy by an electrostatically charged dry powder spray method. Currently approved epoxies are those that have been identified by the National Bureau of Standards and include the following:

Product	Manufacturer
MICCRON 650	Republic Steel
Scotchkote 202	Minnesota Mining & Mfg. Co.
LSU431,Formula 907-2-5	Ciba-Geigy Corp.
Flintflex 531-6020	E.I. DuPont de Nemours, Co., Inc.
Corvel ECA 1558 Red-27000	The Polymer Corp.

3. Preformed Sheet Membrane - Heavy Duty Bituthene - a fabric reinforced rubberized asphalt and bituminous membrane applied over a primer on the deck and edge-sealed with a mastic.

4. Preformed Sheet Membrane - Royston Bridge Membrane No. 10 - a fiberglass mesh reinforced bituminous material with a polyester film backing applied over a synthetic rubber and resin base primer on the deck and edge-sealed with a mastic.

5. Preformed Sheet Membrane - Protecto Wrap M-400 and P-100 - a fiber mat reinforced blend of coal tar and synthetic resins applied over a primer on the deck, edge-sealed with a mastic, and protected with a fiberglass reinforced, tar coated felt.

6. Liquid Membrane - 717-02, Bituminous Epoxy Protective Coating - a two-component, bituminous modified epoxy system applied in two coats to the deck with texturing aggregate applied to the second coat.

7. Liquid Membrane - Wabo-4000; NEA-4000; Superseal 4000 - a hot-applied poly (vinyl chloride) elastomer protected with 65 lb. asphalt roofing felt.

8 Miscellaneous Protective Systems - other types of coated reinforcing steel and membrane systems may be included in this program as they become available and if product information warrants their use.

Although the major effort in this project will be directed toward field trials of these materials, it is anticipated that some laboratory evaluations will be conducted also. The purpose of these laboratory evaluations will be to determine potential screening tests and standards for other protective systems not included in this study.

METHOD. The method for evaluating the performance of the protective systems will be to construct new decks or reconstruct existing decks utilizing the various systems. In general, each system will receive field trials in at least two locations in the State. However, due to the large number of systems being evaluated by other organizations in the Department, it may not be possible to provide two test sites for each system. Additionally, wherever possible a control site will be established at the same location. The control site will be a conventionally constructed bridge deck to be monitored as a comparison for the deck constructed with the protective system. Each system will be applied to at least one entire span but preferably to one entire structure at any one location.

CONSTRUCTION PROCEDURE. Each system will be installed in accordance with the contract specifications. Copies of the current construction specifications are included in the appendix During construction the parameters listed below will be measured for the indicated protective systems if applicable.

	Coated Reinforcing Steel	Membranes
Concrete data: slump, air content, compressive strength, temperatures, etc.	From normal project records	
Chloride content of the deck	x	x
Electrical resistance of deck (California Method)	x	x
Cu-$CuSO_4$ half-cell potential	x	x
Depth of reinforcing steel	x	x
Crack Survey	x	x
Deck surface roughness	-	x
Electrical resistance of membrane	-	x
Membrane bubble density	-	x
Asphalt concrete delivery temperature	-	x
Electrical resistance of wearing course	-	x

In addition, a representative will be on hand to observe all construction operations associated with the installation of the protective system. A complete record of the construction activity will be kept, including all unusual features, damage, etc.

For monitoring purposes, certain instrumentation will be installed in the experimental decks. Specifically, to improve the reliability of the electrical resistance measurements, wires will be attached to several points of the top reinforcing mat and run to a service box to be mounted outside the bridge rail on the deck. In addition an attempt will be made to monitor the moisture content of decks protected by membranes through the installation of moisture sensors. Although several types of sensors are available, the reliability of such systems is not well documented.

POST CONSTRUCTION PROCEDURE. After the structures incorporating the protective systems are placed in service, annual inspections will be made to determine the condition of the bridge decks. The following parameters will be measured at the same random locations on the deck selected during the construction of the deck:

1. - Chloride content
2. - Electrical resistance
3. - Cu-$CuSO_4$ half-cell potential
4. - Crack survey
5. - Visible deterioration of the deck; i.e. spalling, scaling, etc.
6. - Moisture content

Depending on the results of these measurements, the inspection frequency may be increased or decreased to reflect the rate of deterioration. An attempt will be made to determine the number of salt application for the structures involved through Department records.

EVALUATION. The single most important determining factor in evaluating the effectiveness of a protective system is the longevity of the deck. However, for practical purposes, it is important that some type of evaluation of the effectiveness of these systems be accomplished as soon as possible so effective systems may be identified and incorporated in future deck construction.

The parameters to be measured in the annual inspections should provide some interim indication of the performance of these systems. Specifically, the literature has identified tentative standards for both the electrical resistance test and the half-cell potential as indicators of protective system performance. However, there are still many uncertainties in both the measurement technique and the interpretation of the results for both of these tests. It is hoped that the data collected on the experimental decks, as well as the control decks, may provide additional insight into the interpretation of these measurements.

At this time there are no firm definitions of system failure. It is expected that each system will be evaluated based on the total performance of the system at all locations.

REPORTING. It is expected that a report on construction will be generated for each experimental location. Since some locations will encompass more than one protective system a single construction report may cover the installation of more than one protective system. If it appears desirable, an additional construction report contrasting the various systems may be prepared upon completion of construction of all the experimental decks covered by this program.

In addition to the construction report, an annual report will be issued which will include the results of the annual surveys. These annual reports will be issued until such time as a final evaluation of the protective system is completed at which time a final report on the project will be issued.

APPENDIX A

EXPERIMENTAL PROTECTIVE SYSTEMS

AND

PROJECT IDENTIFICATIONS

This Appendix identifies the construction projects and experimental features that will be monitored and evaluated in accordance with the general project work plan. Other protective systems and projects may be added to this study under the "Miscellaneous Protective Systems" category.

For clarity, there follows a summary of the experimental installations. The remainder of this Appendix provides a brief description of each project and experimental feature(s) on an individual basis.

SUMMARY OF EXPERIMENTAL INSTALLATIONS

Protective System	Project Ident. & Location	Page
Epoxy Coated Reinforcing Steel	P.I.N. 4008.00 - Arcade	A-3
	P.I.N. 9357.00 - Sanitaria Springs	A-4
Galvanized Reinforcing Steel	P.I.N. 4008.00 - Arcade	A-3
	P.I.N. 9357.00 - Sanitaria Springs	A-4
Preformed Membrane - Heavy Duty Bituthene	P.I.N. 4040.29 - Rochester	A-5
	P.I.N. 6008.23 - Corning	A-7
Preformed Membrane - Royston Br. Membrane No. 10	P.I.N. 4040.29 - Rochester	A-5
	P.I.N. 6006.42 - Waverly	A-6
Preformed Membrane - Protecto Wrap M-400 & P-100	P.I.N. 4040.29 - Rochester	A-5
	P.I.N. 6006.42 - Waverly	A-6
Liquid Membrane - Bituminous Epoxy Protective Coating	P.I.N. 4040.29 - Rochester	A-5
	P.I.N. 5565.00 - N. Tonowanda	A-8
Liquid Membrane - WABO-4000; NEA-4000; Superseal-4000	P.I.N. 4040.29 - Rochester	A-5
	P.I.N. 6008.23 - Corning	A-7

Project Identification:

P.I.N. 4008.00, F.A. No. RF282(7)
FARC 74-182, County Line - Arcade, State Highway No. 155, Wyoming County
Project Letting Date: November 21, 1974

Experimental Features:

Item 29 EXE, Bar Reinforcement for Structures (Epoxy Coated).
Item 29 EXG, Bar Reinforcement for Structures (Galvanized).

Description of Structure:

H.G.S., Route 39 over Penn-Central RR.
4 Spans, 8" monolothic deck
Epoxy reinforcement on 1 span (80' long x 52' wide)
Galvanized reinforcement on 2 spans (37 & 80' long,) by 52' wide

Control section: Plain (un-coated) reinforcement on 1 span (57' long x 52' wide)

Project Identification:

P.I.N. 9357.00
Interstate Route 508
Sanataria Springs - Harpursville, Completion Contract
Broome County
Scheduled Letting Date: November, 1975

Experimental Features:

Item * , Bar Reinforcement for Structures (Epoxy Coated)
Item * , Bar Reinforcement for Structures (Galvanized)

* Contract Item Number to be assigned

Description of Structures:

All bridge decks will be constructed as 8" monolithic slabs.

Epoxy Reinforcement

Bridge #1 (Twin Structure) - Int. Rte. 508 over Connection Road (133' long x 36' wide.
Bridge #5 (Twin Structure) - Int. Rte. 508 over Route 7 (386' long x 36' wide).
Bridge #7 (Twin Structure) - Int. Rte. 508 over Beech Ridge Road (113' long x 36' wide).

Galvanized Reinforcement

Bridge #3 (Twin Structure) - Int. Rte. 508 over Tunnel Road (300' long x 36' wide).
Bridge #8 (Twin Structure) - Int. Rte. 508 over Relocated Bates Road (145' long x 36' wide).
Bridge #9 (Twin Structure) - Int. Rte. 508 over Relocated Rte. 79 (150' long x 36' wide).

Control Section: Plain (un-coated) reinforcement

A comparable structure from this or adjoining Int. Rte. 508 contracts will be selected and monitored as a control section.

Project Identification:

P.I.N. 4040.29
Route 47, Rochester Outer Loop (East Ave. to Keeler St. Expressway)
Monroe County
Scheduled Letting Date: January, 1976

Experimental Features:

Item 15622.9993, Bridge Bituminous Epoxy Membrane Waterproofing System (Two Coat Application).
Item 15622.9994, Bridge Membrane Waterproofing System (PVC Polymer).
Item 15622.9995, Bridge Preformed Membrane Waterproofing System (Royston Bridge Membrane No. 10).
Item 15622.9996, Bridge Preformed Membrane Waterproofing System (Heavy Duty Bituthene)
Item 15622.9997, Bridge Preformed Membrane Waterproofing System (Protecto Wrap M-400).

Description of Structures:

Bridge deck rehabilitation contract. New asphalt concrete overlay. Overlay thicknesses vary from 2½" to 4".

Item 15622.9996 (Heavy Duty Bituthene)

B.I.N. 1026041 and B.I.N. 1026042 - Twin Structure
S.H. 59-14, Bridge No. 1 over Blossom Road (Route 286A)
(~12,000 sq.ft. - 4" A.C. overlay).

Item 15622.9997 (Protecto Wrap M400 & P100)

B.I.N. 1026059
S.H. 59-14, Bridge No. 2 over Browncroft Road (Route 286)
(~16,500 sq.ft. - 4" A.C. overlay).

Item 15622.9993 (Bituminous Epoxy Protective Coating)

B.I.N. 1026060
Bridge No. 3, Tryon Parkway over Outer Loop
(~4,400 sq.ft. - 2½" A.C. overlay).

Item 15622.9995 (Royston Bridge Membrane No. 10)

B.I.N. 1026070
Bridge No. 4, Winton Road over Outer Loop
(~12,000 sq.ft. - 2½" A.C. overlay)

Item 15622.9994 (WABO-4000; NEA-4000; Superseal-4000)

B.I.N. 1051290
S.H. 56-7, Bridge No. 3, Bayview Road over Outer Loop
(~ 6000 sq.ft. - 2½" A.C. overlay).

Control Section:

B.I.N. 1026089
S.H. 56-7, Bridge No. 1 over Empire Boulevard (Rte. 404)
Work on this bridge will consist of replacing the structural slab. A new, 9¼" monolithic slab with plain (un-coated) reinforcement has been detailed. This structure will be monitored as the control section.

Project Identification:

P.I.N. 6006.42
Routes 17 & 34, Waverly-Owego, Pt. 1; Lockwood-Vanetten, Pt.3
Tioga County
Scheduled Letting Date: October, 1975

Experimental Features:

Item 15622.9995, Bridge Preformed Membrane Waterproofing System (Royston Bridge Membrane No. 10).
Item 15622.9997, Bridge Preformed Membrane Waterproofing System (Protecto Wrap M-400).

Description of Structures:

Reconstruction of bridge decks. New 9" structural slab with 2½" asphalt concrete overlay.

Item 15622.9995 (Royston Bridge Membrane No. 10)

B.I.N. 1023180
S.H. 1078, Route 34 over Lehigh Valley R.R.
(~4,850 sq.ft.)

Item 15622.9997 (Protecto Wrap M-400 & P-100)

B.I.N. 1023170
S.H. 1078, Route 34 over Cayuta Creek
(~6,600 sq.ft.)

Project Identification:

P.I.N. 6008.23
Routes 17 & 15, Corning - Painted Post - W. City Line, Corning
Steuben County
Scheduled Letting Date: July, 1975

Experimental Features:

Item 15622.9994, Bridge Membrane Waterproofing System (PVC Polymer).
Item 15622.9996, Bridge Preformed Membrane Waterproofing System (Heavy Duty Bituthene)

Description of Structures:

Bridge deck rehabilitation contract. New 2½" asphalt concrete overlay.

Item 15622.9994 (WABO-4000; NEA-4000; Superseal-4000)

B.I.N. 1011200
Bridge No. 3, Routes 15 & 17 over Cohocton River
(9-span structure, ~3,250 sq.ft./span)

Item 15622.9996 (Heavy Duty Bituthene)

B.I.N. 1012710
Bridge No. 4 (Twin Structure), Route 15 over Erie-Lackananna R.R. (~ 10,500 sq.ft./structure).

Control Section:

B.I.N. 1012710
Bridge No. 2, Route 17 over Chemung River
Work on this bridge will consist of replacing a 4" concrete wearing course. A new 4" concrete overlay will be placed, without membrane treatment. This structure will be monitored as a control section.

Project Identification:

Note: This is a non-Federal Aid project.

P.I.N. 5565.00
Delaware Avenue Bridge, Canal Bridge No. E-247
Erie & Niagara Counties
Scheduled Letting Date: July, 1975

Experimental Feature:

Item 15622.9993, Bridge Bituminous Epoxy Membrane
Waterproofing System (Two-Coat Application)

Description of Structure:

B.I.N. 4453030
Delaware Avenue over Barge Canal (3 spans)
Bridge deck rehabilitation contract. New 2½" asphalt concrete overlay. Bituminous epoxy membrane will be placed on Spans 1 & 2 (~ 8,400 sq.ft.) Span 3 will be monitored as a control section.

APPENDIX B

CONTRACT SPECIFICATIONS

EXPERIMENTAL PROTECTIVE SYSTEMS

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BAR REINFORCEMENT FOR STRUCTURES

(EPOXY COATED)

ITEM 28EXG

Description:

This work shall consist of furnishing and placing epoxy coated bar reinforcement for structures. Epoxy coated bar reinforcement shall be placed where indicated on the Contract Plans.

Materials:

A. Bar Reinforcement: Bar reinforcement shall meet the requirements of Subsection 709-01, Bar Reinforcement for Cement Concrete.

B. Epoxy Coating:

1.0 Scope: This portion of the specification covers the protective epoxy coating applied by the electrostatic spray method to steel bars used as concrete reinforcement. Under the terms of this specification, the bar reinforcement may be bent prior to coating with epoxy or subsequent to coating with epoxy.

2.0 Coating Process:

The coating shall be applied as an electrostatically charged dry powder sprayed onto the grounded steel bar using an electrostatic spray gun. The powder may be applied to either a hot or cold bar. The coated bar shall be given a thermal treatment specified by the manufacturer of the epoxy resin which will provide a fully cured finished coating.

3.0 Coating Material: The coating material used shall be a powdered epoxy resin selected from one of the following:

Product	Manufacturer
MICCRON 650	Republic Steel
Scotchkote 202	Minnesota Mining and Manufacturing Co.
LSU431, Formula 907-2-5	Ciba-Geigy Corp.
Flintflex 531-6020	E. I. DuPont de Nemours Co., Inc.
Corvel ECA-1558 Red-27000	The Polymer Corp.

The powdered resin shall conform to the specification of the manufacturer and shall be of the same material and quality submitted to the National Bureau of Standards for evaluation and test.

The manufacturer of the epoxy resin shall supply to the coating applicator information on the resin that he considers essential to the proper use and performance of the resin as a coating. The manufacturer of the resin shall also furnish the coating applicator written certification signed by a responsible officer of the company that the material furnished for the coating of the reinforcing steel is the same formulation as that previously submitted to the National Bureau of Standards for evaluation as identified herein. The coating applicator shall supply to the Materials Bureau a representative sample of 8-ounces of the resin powder used to coat each given lot of bars. The sample shall be packaged in an air-tight container with identification by lot number.

The applicator shall supply to the Materials Bureau four coated steel panels 4 x 4 x 0.050-inch coated with a 7-mil ± 2-mil coating of the same lot of resin used on the bars and coated by the same method. These panels will be used to determine abrasion resistance as specified under paragraph B. 9.0, Abrasion Resistance.

4.0 Patching Material: Patching or repair material, compatible with the coating and inert in concrete, shall be made available by the epoxy resin manufacturer. The material must be suitable for repairs made by the installation contractor, of areas of the coating damaged during fabrication or handling in the field.

5.0 Surface Preparation: The surface of bars to be coated shall be clean and free from rust, scale, oil, grease and similar surface contaminants.

The surface shall be blasted to near white metal in accordance with the Steel Structure Painting Council Surface Preparation Specification SSPC-SP5-63T, amended.

All traces of grit and dust from the blasting shall be removed.

The coating shall be applied to the cleaned surface as soon as possible after cleaning and before visible oxidation of the surface occurs.

6.0 Coating Thickness: A film thickness, after curing, of 7 mils ± 2 mils shall be applied in a uniform, smooth coat. Thickness of the film shall be measured on a representative number of bars from each production lot by the same method as outlined in ASTM Designation G12-69T for measurement of film thickness of pipeline coatings on steel.

The coating film shall be cured or post cured to a fully cured condition; a representative proportion of each production lot shall be checked by the coating applicator, using the method he has found most effective for measuring cure, to insure that the entire production lot of coating is supplied in the fully cured condition.

7.0 Continuity of Coating: The coating shall be checked after cure for continuity of coating and shall be free from holes, voids, contaminations, cracks and damaged areas. In addition, there shall not be more than two holidays (pinholes not visually discernible) in any linear foot of the coated bar.

A holiday detector shall be used in accordance with the manufacturer's instructions to check the coating for holidays. A 67-1/2-volt detector such as the Tinker and Rasor Model M-1 or its equivalent shall be used.

8.0 Flexibility of Coating: The following provisions shall apply equally to bars bent prior to epoxy coating, and bars bent subsequent to epoxy coating.

The flexibility of the coating shall be evaluated on a representative number of bars selected from each production lot. A No. 6 reinforcing bar shall be capable of being bent 120 degrees over a wooden mandrel of 3-inch radius without visible evidence of cracking of the coating.

The bending test shall be conducted at room temperature after the specimen has been exposed to room temperature for a sufficient time to insure that it has reached thermal equilibrium. A temperature in the range of 20 to 30°C (68 to 85°F) shall be considered room temperature.

9.0 Abrasion Resistance: The resistance of the coating to abrasion by a Taber abraser or its equivalent using CS-10 wheels and a 1000-gram load per wheel shall be such that the weight loss shall not exceed 100 mg. per 1000 cycles.

10.0 Fabrication of Coated Bars: Where fabrication damages the coating, repair shall be made by the fabricator using patching material as specified in Section B. 4.0 in accordance with procedures specified by the resin manufacturer.

11.0 Test: The coating applicator shall perform all tests previously described except Abrasion Resistance. The Abrasion Resistance test shall be performed by the Materials Bureau.

The coating applicator shall include one reinforcing bar test specimen which will be a minimum of 3 feet (914.4 mm) long, for each lot or 100 reinforcing bars, whichever is smaller. The test specimen shall have the same diameter as the lot bars and shall be coated at the same time and in the same manner, with the same material as the bars it represents. If the test specimen fails any one of the tests for coating thickness, continuity of coating, or flexibility of coating, the lot it represents will be assumed to have failed the same test and will not be allowed to be incorporated in the work.

For test purposes, a lot is any one of the following:

a. One or more reinforcing bars of the same type and size comprising a single order or delivery load, whichever is smaller.

b. A number of reinforcing bars identified as a lot by the coating applicator providing the bars comprising the lot have all been coated within a single production shift.

c. One hundred reinforcing bars of the same size and type. Notwithstanding a and b above, no lot shall exceed one hundred bars.

12.0 The Materials Bureau shall be notified 30 days prior to the beginning of any coating application. The Materials Bureau representative and any other Department authorized representative shall have free access to the plant for inspection. Work done while any Department representative has been refused access shall be automatically rejected.

If the representative so elects, preparation of the bars, coating and curing of the bars shall be done in his presence.

On a random basis, lengths of coated bars may be taken by the State's representative from the production run at the point of coating application for test, evaluation and check purposes.

13.0 Basis of Acceptance: The coating applicator shall furnish a Certificate of Compliance with each shipment of coated bars. The Certificate of Compliance shall state that representative samples of the coated bars have been tested in accordance with the terms of this specification and that the results conform to the requirements of this specification.

Test results shall be retained for five years and shall be made available to the Department if requested. The Certificate of Compliance and all documentation required by Subsection 710-01, Bar Reinforcement for Cement Concrete, shall accompany each shipment to the work site.

14.0 Handling and Shipping: Research has indicated that the suggested coatings will withstand considerable abuse. However, the coating cannot withstand cutting or mashing. Therefore, the fabricator will be held responsible for damage to the coatings by requiring that he patch, with the material specified in paragraph B. 4.0, all cuts or mashed areas in excess of 2 per 10 feet of bar. In addition, the fabricator will be required to patch all sheared or cut ends of bars and any areas where the entire coating is removed by abrasion or chipping. It is not intended that the fabricator be required to patch cracking due to bending or those bends that will be placed in areas protected from chloride exposure when placed in the structure, such as bends placed in deck overhangs protected by the roadway curb or those at the bottom of the deck slab. All repairs will be applied as soon as practicable and in the case of sheared ends, before visible oxidation of the surface occurs.

Coated bars will be bundled together for shipment by use of excelsior or equivalent padded metal bands. All personnel responsible for loading or unloading coated bars will use caution to avoid dragging or dropping the bundles. If, during shipment, severe damage results, the damaged product will be returned to the fabricator for repair or replacement.

Construction Details:

Bar Reinforcement:

A. Ordering: Prior to ordering reinforcing steel, the Contractor shall carefully check all bar lists and assume full responsibility for their accuracy.

No changes in the bar list shall be made by the Contractor unless approved by the Deputy Chief Engineer (Structures).

B. Field Bending: No field bending will be permitted.

C. Splices: Splices shall be permitted only where shown on the Contract Plans. Should the Contractor desire to splice bars at locations other than those shown on the Contract Plans, he shall first obtain written permission to do so from the Deputy Chief Engineer (Structures). Such permitted splices shall be well distributed or located at points of low tensile stress. Splices shall not be permitted unless a minimum of two clear inches can be provided between the spliced bar and the nearest adjacent bar.

Splices for bars No. 11 or smaller, shall be made by placing the bars in contact and wiring them together for the full length of the splice with plastic-coated tie wire.

Splices for bars larger than No. 11 shall be made by positive connections. These connections shall develop, in tension, at least 90 percent of the specified minimum tensile strength of the reinforcing bar.

Proposed methods and details of positive connected splices shall be submitted to the Deputy Chief Engineer (Structures) for his approval. These areas shall be patched or repaired as specified in Section 2, Materials, Subsection B 4, Patching Material.

Any proposed welding must be done in accordance with the welding requirements of the New York State Steel Construction Manual, except that radiographic inspection will not be required.

D. Placement:

1. General:

Prior to placing epoxy coated reinforcing steel, all grease, dirt, mortar, and any other foreign substance must be removed from the epoxy coated reinforcing steel.

The reinforcement shall be placed in the position indicated by plastic or plastic-coated wire supports, and within the allowable tolerances specified. Before concrete is placed, all reinforcement shall be securely fastened and supported with approved plastic or plastic-coated metal chairs or other approved devices.

Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision shall be rejected and removed.

2. Placement in Bridge Slabs:

Bar supports shall be spaced no farther apart than 4'-0" center-to-center, nor shall any bar support be closer than 6 inches from the edge of any future concrete surface. Bridge slab bar reinforcement shall be placed in accordance with the following tolerances:

Vertical - ± 1/4 inch
Horizontal - ± 1/2 inch

The bridge slab bar reinforcing mats (top and bottom) shall be securely connected together. This connection may be accomplished by wiring with plastic-coated tie wire or other means approved by the Engineer. Connections shall be placed no farther apart than 4 feet on center. The bar supports may be utilized for this purpose. Connecting devices shall neither cut nor mash the epoxy coating. Neither shall they deflect the bar reinforcement nor interfere with the smooth flow of concrete.

Visual inspection and repair of the coated steel at the construction site will be postponed until the steel is in place. This procedure will limit the task of inspection and repair to one operation and to that which is absolutely essential. The Engineer shall designate those areas of coated steel to be repaired. However, it will not be necessary to repair minor cuts, pinholes or holidays.

Immediately subsequent to the placement of concrete, the Engineer shall verify at random, that the vertical clear distance from the top of slab to the top mat of main reinforcing, as shown on the Contract Plans, is correct within the tolerances allowed in this section. If the allowable tolerances are exceeded, the Engineer shall reject the work and shall so advise the Contractor and the Deputy Chief Engineer (Structures), in writing, stating the deficiencies upon which the rejection is based. The Deputy Chief Engineer (Structures) shall review the nature and extent of the deficiencies and shall designate one of the following alternatives:

a. The affected concrete placement shall be removed and replaced in whole or part.

b. The Contractor shall provide special corrective measures as directed by the Deputy Chief Engineer (Structures).

c. The concrete placement shall be accepted without corrective action.

The concrete replacement or other corrective work which the Contractor is directed to perform shall be accomplished at no additional cost to the State.

Method of Measurement:

Epoxy coated bar reinforcement shall be measured by the number of pounds of epoxy coated steel bars placed. The weight of bar reinforcement will be computed by the Engineer utilizing the unit weight for each size bar. Unit weights for computation shall be as given in Subsection 709-01. No allowance for the weight of the epoxy coating will be made. The unit weight of the bar in its uncoated state will be the basis for measurement in the field.

Basis of Payment:

The unit price bid per pound of epoxy coated reinforcing steel shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. The unit price shall also include the furnishing and placing of chairs, supports and fastenings as well as any splices not specifically shown on the Plans. If the Engineer permits the substitution of larger bars than those specified, or splices not shown on the plans or specifically ordered by him, payment will be made only for the amount of steel which would have been required, if the specified size and length of bar had been used.

BAR REINFORCEMENT FOR STRUCTURES (GALVANIZED)

ITEM-28EXG

DESCRIPTION:

This work shall consist of furnishing and placing galvanized reinforcing steel for structures where indicated on the Contract Plans.

MATERIALS:

A. Reinforcing Steel.

The material for the reinforcing steel shall meet the requirements of Subsection 709-01 Bar Reinforcement for Cement Concrete.

B. Zinc Coating (Galvanizing).

1.0 Scope. This portion of the specification covers the galvanized coating as applied, by the methods required herein, to steel bars used as concrete reinforcement. Under the terms of this specification the bars shall be bent prior to galvanizing.

The reinforcement shall be shop bent to the shapes shown on the Plans and then galvanized. Unless shown otherwise on the Plans, the radii of bends, measured to the inside face of the bent bar, shall be equal to or greater than three times the diameter of the bar. Bends in stirrups shall be equal to or greater than the diameter of the bars.

2.0 Coating Material. The zinc used for the coating shall meet the requirements of A.S.T.M. Specification B6 for Zinc Metal (Slab Zinc) and shall be at least equal to the grade designated as "Prime Western".

3.0 Coating Process. The zinc coating shall be applied by the hot dipping method meeting the requirements of A.S.T.M. Specification A-123 Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip.

4.0 Quenching. The reinforcing bars shall be quenched as soon as possible after galvanizing. Quenching may be combined with chromate treatment as indicated in the subsection for Chromate Treatment.

5.0 Chromate Treatment. The galvanized reinforcement bars shall be chromate treated. If the chromate treatment is performed immediately after galvanizing it may be accomplished by means of quenching the reinforcement bars in a solution containing at least 0.2%, by weight, of sodium dichromate in water. (i.e. 3 oz. for each 10 gal. of quench water) or by quench chromating in a minimum 0.2% chromic acid solution. The solution shall be at least 90°F. The galvanized reinforcement bars shall be immersed in the solution for at least 20 seconds. If the galvanized reinforcement bars had previously been quenched the chromate treatment shall be the same as specified above except that 0.5 to 1.0% concentration of sulfuric acid shall be added as an activator to the chromate solution.

6.0 Embrittlement of Steel. The coating applicator shall take the necessary precautions to properly fabricate and prepare the bars for galvanizing to prevent embrittlement by conforming to the requirements of A.S.T.M. Specification Recommended Practice A-143 Safeguarding Against Embrittlement of Hot Galvanized Structural Steel Products and Procedure for Detecting Embrittlement. However, the test for embrittlement shall be conducted by the coating applicator or his representative according to the bend test described in A.S.T.M. Specification A-615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. The coating applicator shall include one reinforcing bar test specimen at least 3 ft. (914.4 mm) long for each lot or for every 100 bars, whichever is smaller, for this testing. The test specimen shall have the same diameter as the lot members and shall be galvanized at the same time in the same manner in the same pot and quenched and chromate treated at the same time and manner as the bars whose characteristics it is intended to indicate. If the test specimen cracks, or otherwise fails the bend test, it shall be assumed that the lot it represents has been embrittled during galvanizing. A lot of galvanized reinforcing bars assumed to be embrittled by this test can not be used in the work and shall be rejected. This testing is destructive and the test specimen can not be incorporated in the work.

For test purposes, a lot is any one of the following:

A. One or more reinforcing bars of the same type and size compromising a single order or delivery load, whichever is smaller.

B. A number of reinforcing bars identified as a lot by the coating applicator, providing the bars compromising the lot have all been coated within a single production shift.

C. One hundred reinforcing bars of the same size and type. Not withstanding A. and B. above, no lot shall exceed one hundred bars.

7.0 Weight of Coating. The weight of the zinc coating shall average not less than 2.3 oz./sq. ft. (702 g/m^2) and no individual measurement shall show less than 2.0 oz./sq/ft. (610 g/m^2). The average coating weight may be determined by three magnetic thickness gauge measurements conducted on three bars of each lot up to 100 members, in accordance with A.S.T.M. Recommended Practice E-376 Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.

Should the three selected bars fail to meet these requirements, the lot shall be rejected and shall not be allowed to be used in the work.

8.0 Fabrication. The reinforcement bars shall be galvanized after fabrication in accordance with the drawings. It is the responsibility of the Contractor to coordinate the tagging and identification requirements for the project and to provide a non-destructive metal tag system.

9.0 Coating Repair Method. When a coated reinforcement bar suffers minor damage during shipment or construction, field repairs shall be made in accordance with Subsection 719-01 Galvanized Coatings and Repair Methods. Field repairs must be made when the area of coating damage is greater than the cross-sectional area of the reinforcement bar. Shop repairs are not allowed. Bars which have a damaged coating prior to shipment must be stripped and regalvanized.

10.0 Inspection. The Materials Bureau shall be notified 30 days prior to the beginning of the coating application. The Materials Bureau representative and any other Department authorized representatives shall have free access to the plant for inspection. Work done while any Department representative has been refused access shall be automatically rejected.

If the representative so elects, preparation of the bars, coating, quenching and chromate treating shall be done in his presence. On a random basis, lengths of coated bars may be taken by the representative from the production run at the point of coating application for test, evaluation and check purposes.

11.0 Basis of Acceptance. The coating applicator shall furnish a Certificate of Compliance with each shipment of coated bars. The Certificate of Compliance shall state the representative samples of the coated bars have been tested and that the test results conform to the requirements described herein. Test results shall be retained and made available, if requested. The Certificate of Compliance and the documentation required for uncoated reinforcement bars by Subsection 709-01 Bar Reinforcement for Cement Concrete shall accompany each shipment to the job site.

12.0 Handling and Shipping. The coated bars will be bundled together for shipment by use of excelsior or equivalent padded metal bands. All personnel responsible for loading or unloading coated bars will use caution to avoid dragging or dropping the bundles. If, during shipment, severe damage results, the damaged product will be returned to the fabricator for replacement, or regalvanizing.

CONSTRUCTION DETAILS:

A. Bar Reinforcement.

1.0 Ordering. Prior to ordering reinforcing steel, the Contractor shall carefully check all bar lists and assume full responsibility for their accuracy. No changes in the bar list shall be made by the Contractor unless approved by the Deputy Chief Engineer (Structures).

2.0 Field Bending. No field bending will be permitted.

B. Placement - General.

1.0 Prior to placing galvanized reinforcement steel, all grease, dirt, mortar, wet storage stains (white rust) and any other foreign substance must be removed from the galvanized reinforcement steel. After removal of these deposits the coating shall have a uniform appearance free from uncoated spots, lumps, blisters, gritty areas, acid flux and black spots. Materials with these defects will be rejected and immediately removed from the work site. Acceptable material will be provided to replace rejected material at no additional expense to the State.

The steel reinforcement shall be placed in the position indicated and within the allowable tolerances specified. However, the galvanized reinforcement steel shall not be electrically coupled to unprotected steel or other dissimilar metals. Bar supports shall be plastic coated with a di-electric material. Tie wire shall be annealed wire 16-gage or heavier and galvanized. Polyethylene or a similar di-electric tape shall be used to provide local insulation between dissimilar metals that would otherwise be in contact. Before concrete is placed, all reinforcement shall be securely fastened and supported with the approved materials and by the methods herein described.

2.0 Splices. Splices shall be permitted only where shown on the Contract Plans. Should the Contractor desire to splice bars at locations other than those shown on the Contract Plans, he shall first obtain written permission to do so from the Deputy Chief Engineer (Structures). Such permitted splices shall be well distributed or located at points of low tensile stress. Splices shall not be permitted unless a minimum clearance of two inches can be provided between the spliced bar and the nearest adjacent bar. Splices shall be made by placing the bars in contact and wiring them together for the full length of the splice with galvanized tie wire. Other types of positive connections shall develop in tension, at least 90% of the specified minimum tensile strength of the reinforcing bar. Proposed methods and details for positive connected splices shall be submitted to the Deputy Chief Engineer (Structures) for approval.

3.0 Inspection. Concrete shall not be placed until the galvanized reinforcing steel is inspected and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision shall be rejected and removed.

C. Placement in Bridge Slabs.

Bar supports shall be spaced no farther apart than 4'-0" center-to-center, nor shall they be closer than 6" from the edge of any future concrete surface. Bridge slab bar reinforcement shall be placed in accordance with the following tolerances:

Vertical - $\pm$ 1/4"
Horizontal - $\pm$ 1/2"

The bridge slab reinforcing bar mats (top and bottom) shall be securely connected together. This connection may be accomplished by wiring or other means approved by the Engineer. Connections shall be placed no farther apart than four feet on center. The bar supports may be utilized for this purpose. Connecting devices shall neither deflect the bar reinforcement nor interfere with the smooth flow of concrete.

Concrete shall not be placed until the galvanized reinforcing steel is inspected and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision shall be rejected and removed at the expense of the Contractor.

The zinc coating on the reinforcing steel will withstand considerable abuse. However, the coating can be damaged when proper care is not exercised during shipping and construction handling. Therefore, the Contractor will be required to repair damage to the coatings as specified in paragraph B 9.0 of the Materials portion of this specification. Visual inspection and repair of the coated steel at the construction site will be delayed until the steel is in place. This procedure will limit the task of inspection and repair to one operation and to that which is absolutely essential. The Engineer shall designate those areas of coated steel to be repaired.

Verification.

Immediately subsequent to the placement of concrete, the Engineer shall verify at random that the vertical clear distance from the top of slab to the top mat of main reinforcing, as shown on the Contract Plans, is correct within the tolerances allowed in this specification. If the allowance tolerances are exceeded, the Engineer shall reject the work and shall so advise the Contractor and the Deputy Chief Engineer (Structures), in writing, stating the deficiencies upon which the rejection is based. The Deputy Chief Engineer (Structures) shall review the nature and extent of the deficiencies and shall designate one of the following alternatives:

A. The affected concrete placement shall be removed and replaced in whole or part.

B. The Contractor shall provide special corrective measures as directed by the Deputy Chief Engineer (Structures).

C. The concrete placement shall be accepted without corrective action.

The concrete replacement or other corrective work which the Contractor is directed to perform shall be accomplished at no additional cost to the State.

METHOD OF MEASUREMENT:

Galvanized Reinforcing Steel shall be measured by the number of pounds of coated bars placed in accordance with the Plans and Specifications. The weight of bar reinforcement will be computed by the Engineer utilizing the unit weight for each size bar. The unit weight for computation shall be given in Subsection 709-01. No allowance for the weight of the galvanized coating will be made. The unit weight of the bar in its uncoated state will be the basis for measurement in the field.

BASIS OF PAYMENT:

The unit price bid per pound of galvanized reinforcing steel shall include the furnishing of all labor, materials and equipment necessary to complete the work. The unit price shall also include the cost of furnishing and placing of chairs, supports, fastenings, and connections, as well as any splices not specifically shown on the Plans. If the Engineer permits the substitution of larger bars than those specified, or permits splices not shown on the Plans, or specifically ordered by him, payment will be made only for the amount of steel which would have been required, if the specified size and length of bar had been used.

December 13, 1974
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ITEM - 15622.9993 BRIDGE BITUMINOUS EPOXY MEMBRANE WATERPROOFING SYSTEM (TWO COAT APPLICATION).

DESCRIPTION: This work shall consist of furnishing and applying a bituminous epoxy waterproofing system. It shall include the preparation of concrete surfaces; the application of two coats of bituminous epoxy protective coating and the application of coarse aggregate as shown on the contract plans.

MATERIALS: The bituminous epoxy membrane waterproofing system shall consist of materials meeting the requirements of the following subsections of Section 700 - Materials.

Bituminous Epoxy Protective Coating	717-02
Coarse Aggregate	703-02

Wire mesh, for use over sub-drainage openings, shall be a ¼" mesh by 23 gauge, hot dipped galvanized cloth.

CONSTRUCTION DETAILS:

A. Preparation of Concrete Structural Slab Surfaces:

Work shall not begin on new structural slabs until a minimum of 7 days after concrete placement.

All structural slab surfaces to be waterproofed, including vertical surfaces shall be prepared and cleaned as follows:

1. All loose material, including dirt, stones, gravel and concrete laitance shall be first removed by vacuuming or blowing with compressed air.

2. The entire structural slab surface shall be sandblasted. Sandblast operations shall be done to the extent that excess laitance (surface film of concrete mortar), road oil, other bituminous based contaminants and other foreign materials, including concrete curing compounds and previous membrane treatments are removed. If necessary, the blasting operation shall be supplemented by wire brushing or washing with water. At the completion of sandblasting operations, all blasting residue shall be removed by vacuuming or blowing with compressed air.

3. All surface projections, including exposed aggregate and other protrusions greater than ¼ inch in height shall be ground smooth or grouted smooth with cement or epoxy mortar. Sharp concrete edges shall be ground smooth. Potholes and spalled areas shall be patched with cement or epoxy mortar. Patching and grinding operations shall be done to the extent that the surface roughness of the structural slab does not exceed ¼ inch per foot. If grouting materials are used they shall be cured and surface dry prior to the application of bituminous epoxy protective coating. Cement mortar mixes for use in grouting shall be approved by the Engineer prior to use. Epoxy mortar materials shall consist of epoxy material meeting the requirements of Material Specification 717-02, 721-01, 721-02, or 721-03,

and dry fine aggregate as approved by the Engineer.

4. If necessary, immediately preceding the application of bituminous epoxy protective coating, surfaces to be waterproofed shall be re-cleaned of dust and other loose foreign material that may have accumulated by vacuuming or blowing with compressed air.

B. Atmospheric Conditions:

Work shall not be done during wet weather conditions nor when atmospheric conditions are such that unsatisfactory results will be produced. The Engineer shall be the sole determinate of favorable atmospheric conditions. No work shall be done when the concrete structural slab surface temperature is below 50°F or ambient temperatures are below 50°F or when the relative humidity is greater than 85%. The concrete structural slab shall be surface dry at the time of application of bituminous epoxy protective coating.

C. Application of Bituminous Epoxy Membrane Waterproofing System:

After cleaning operations have been completed, surfaces to be waterproofed shall be covered with two coats of bituminous epoxy protective coating and one application of coarse aggregate.

Concrete structural slab or previously coated surfaces shall be surface dry at the time of application of bituminous epoxy protective coating.

If necessary, the Contractor shall protect uncured coats of bituminous epoxy protective coating against rain or other detrimental elements. Protection shall be provided for the time period required for the bituminous epoxy to field cure.

For purposes of this specification, field cure is determined as the time required for the bituminous epoxy to cure to a firm, hard state, such that no movement of the film or damage occurs due to foot traffic.

Each coat of bituminous epoxy protective coating shall be applied at the rate of 30-35 square feet per gallon. The bituminous epoxy shall be thoroughly mixed prior to use. Mixing shall be done with mechanical mixers or hand mixed, using clean paddles or other suitable instruments. Care shall be taken to minimize the introduction of air bubbles in the epoxy during mixing. The bituminous epoxy shall be applied without dilution. The first coat shall be applied and thoroughly worked into the structural slab surface by the use of brushes or rollers or squeeges or a combination of these methods. Spray application of the first coat of bituminous epoxy shall not be allowed. The second coat may be applied by airless spray or any of the preceding methods.

The first coat of bituminous epoxy shall be applied and allowed to obtain a field cure prior to the application of the second coat. Coarse aggregate

shall not be spread in the first coat. The appearance of bubbles in the bituminous epoxy is normal, due to out-gassing of air and moisture in the concrete. When the field cure has been obtained, bubbles in the first coat shall be broken as much as possible with squeeges or brooms. Unless otherwise directed by the Engineer, it shall not be necessary to repair the areas where bubbles have been broken.

The second coat of bituminous epoxy shall be placed as soon as possible after the first coat has field-cured. In any event the second coat shall be applied within 12 hours after placement of the first coat. If the second coat has not been applied within the 12-hour time period the dried surface of the first coat shall be roughed-up by sandblasting (brush-off blasting) and the sandblasting residue removed. Sandblasting and cleaning shall be at the Contractor's expense. Coarse aggregate shall be applied immediately after the application of the second coat of bituminous epoxy. The aggregate shall be spread while the epoxy surface is still wet and before any substantial degree of cure has been obtained. The primary size of coarse aggregate shall be No. 1, except that material passing the No. 200 sieve shall not exceed 0.5%. The coarse aggregate shall be surface dry and shall be spread on the wet bituminous surface at a rate of between 6 to 9 pounds per square yard (0.67 to 1.0 lbs. per square ft.). The pictorial standards of the Materials Bureau shall be used to visually define the application rate of aggregate.

The vertical faces of curbs, headers and scuppers shall be coated with two coats of bituminous epoxy and finished off in a neat line, to a height that will be at least 1 inch higher than the height of bituminous overlay. To seal the interface, if vertical faces are coated before or after the general application of a coat of bituminous epoxy on the horizontal deck, the coating shall extend down the vertical face and onto the horizontal structural slab or bituminous membrane for a minimum of 2 inches, as applicable. Coarse aggregate shall not be applied to vertical surfaces.

The inside surfaces of sub-drainage outlets (weep tubes) shall be coated with two coats of bituminous epoxy to a depth of at least 1 inch. Immediately after placement of the second coat, 5-inch square pieces of wire mesh shall be pressed into the wet epoxy over each sub-drainage opening. The wire mesh shall be placed before the coarse aggregate is spread on the second coat of bituminous epoxy. Coarse aggregate shall not be applied to the inside surfaces of sub-drainage outlets.

The completed membrane waterproofing system shall be free of large air bubbles and other placement defects. These shall be corrected as directed by and to the satisfaction of the Engineer. Bubbles of 1 inch diameter and greater shall be vented by piercing with an ice pick or other suitable instrument and expelling the air. Vented bubbles in the second coat of bituminous epoxy shall be sealed against water intrusion by "touching-up" with bituminous epoxy.

Throughout the duration of work the Contractor shall protect all exposed areas

of curbs, sidewalks, railings and other bridge appurtances. Any damage or defacement resulting from the application of the membrane system shall be repaired to the satisfaction of the Engineer, at no cost to the State.

METHOD OF MEASUREMENT:

The work shall be measured as the number of square feet of actual horizontal surface area covered with the complete membrane waterproofing system. No separate measurement for the vertical faces of curbs, headers and scuppers or the inside surfaces of sub-drainage outlets shall be made.

BASIS OF PAYMENT:

The unit price bid per square foot for this item, shall include the cost of furnishing all labor, materials (including wire mesh) and equipment necessary to complete the work.

SPECIAL NOTE

PROTECTION AND OVERLAYING OF BRIDGE BITUMINOUS EPOXY MEMBRANE WATERPROOFING SYSTEM (TWO COAT APPLICATION)

Foot traffic on the exposed waterproofing system shall be minimized to the greatest possible extent. Vehicular traffic shall be prohibited until the bituminous concrete overlay operation has started. Bituminous concrete pavers shall be rubber-tired. Vehicles transporting the overlay material shall be rubber-tired and operated at slow speeds (not to exceed 5 mph). All vehicles shall avoid from making sharp turns, sudden starts and stops or other movements on the membrane that may cause breaks, lifting or other damage. Traffic operation on the membrane shall be at the discretion of the Engineer.

Any damage to the membrane during the overlay operation shall be repaired immediately and prior to the placement of bituminous concrete. Repairs shall be made by placing additional bituminous epoxy over the defect at the rate of 15 square feet per gallon. The repair shall extend at least 2 inches in every direction beyond the edge of the defect. Overlay material may be placed over the patched area without waiting for the bituminous epoxy to cure.

ITEM - 15622.9994 BRIDGE MEMBRANE WATERPROOFING SYSTEM
(PVC POLYMER)

DESCRIPTION: This work shall consist of furnishing and applying a liquid, poly-vinyl chloride polymer waterproofing system. It shall include the preparation of concrete surfaces; the application of one coat of hot applied PVC polymer waterproofing and protective sheet as shown on the Contract Plans.

MATERIALS: The bridge membrane waterproofing system shall consist of the following materials:

PVC Polymer Waterproofing - Liquid polymer waterproofing material shall be one of the following:

1. NEA-4000, as manufactured by POSH Chemical, Inc., Port Washington, NY.

or

2. Superseal-4000, as manufactured by Superior Products Co., Oakland, CA.

or

3. WABO-4000, as manufactured by Watson-Bowman Associates, Inc., Buffalo, NY.

Protective Sheet - 65-lb. asphalt roofing paper, meeting the requirements of ASTM D-224, 65-lb. Grade.

Wire Mesh - for use over subdrainage openings shall be a ¼ inch mesh by 23 gauge, hot dipped galvanized cloth.

Note: Containers of PVC polymer waterproofing material shall be stored on the work site in such a manner as to prevent their exposure to direct sunlight and to temperatures exceeding 100°F.

CONSTRUCTION DETAILS:

A. Preparation of Concrete Structural Slab Surfaces:

Work shall not begin on new structural slabs until a minimum of 7 days after concrete placement.

All structural slab surfaces designated to receive liquid waterproofing materials, including vertical surfaces shall be prepared and cleaned as follows:

1. All loose material, including dirt, stones and gravel shall first be removed by vacuuming or blowing with compressed air.

2. The entire structural slab surface shall be sandblasted. Sandblast operations shall be done to the extent that excess laitance (surface film of concrete mortar), road oil, other bituminous based contaminants and foreign materials, including concrete during compounds and previous membrane treatments are removed. If necessary the blasting operation shall be supplemented by wire brushing or washing with water. At the completion of sandblasting operations, all blasting residue shall be removed by vacuuming or blowing with compressed air.

3. All surface projections, including exposed aggregate and other protrusions greater than ¼ inch in height shall be ground smooth or grouted smooth with cement or epoxy mortar. Sharp concrete edges shall be ground smooth. Potholes and spalled areas shall be patched with cement or epoxy mortar. Patching and grinding operations shall be done to the extent that the surface roughness of the structural slab does not exceed ½ inch per foot. If grouting materials are used they shall be cured and surface dry prior to the application of PVC waterproofing material. Cement mortar mixes for use in grouting shall be approved by the Engineer prior to use. Epoxy mortar materials shall consist of epoxy material meeting the requirements of Material Specification 721-01, 721-02, or 721-03, and dry fine aggregate as approved by the Engineer.

4. If necessary, immediately preceding the application of the PVC waterproofing, surfaces to be waterproofed shall be re-cleaned of dust and other loose foreign material that may have accumulated, by vacuuming or blowing with compressed air.

B. Atmospheric Conditions:

Work shall not be done during wet weather conditions nor, when atmospheric conditions are such that unsatisfactory results will be produced. The Engineer shall be the sole determinant of favorable atmospheric conditions. No work shall be done when the concrete structural slab surface temperature is below 40°F or ambient temperatures are below 40°F. The concrete structural slab shall be surface dry at the time of application of the PVC waterproofing material.

C. Application of PVC Polymer Waterproofing Material:

After cleaning operations have been completed, surfaces to be waterproofed shall be coated with one coat of PVC polymer waterproofing material. The PVC waterproofing shall be hot applied at a minimum rate of 17.8 square feet per gallon (minimum wet film thickness of 90 mils) and at a temperature of from 275°F to 300°F. All concrete structural slab surfaces shall be surface dry at the time of application of waterproofing material.

The PVC waterproofing material, as supplied in its container, is ready for pouring into the heating vessel. The heating vessel shall be double-boiler, indirect-fired or oil-bath melter-applicator type kettle. Heating with direct flame shall not be allowed. Heating equipment shall be inspected and approved by the Engineer prior to use. When the application temperature (275-300°F) has been attained, the hot polymer material shall be poured directly onto the structural slab and spread at the specified application rate, using squeegees. Brushes and rollers may be used to supplement the squeegee operation.

The vertical faces of curbs, headers and scuppers shall be coated with hot PVC waterproofing and finished off in a neat line, to a height that will be at least 1 inch higher than the height of bituminous overlay. If necessary on the vertical face multi-coat applications shall be made to obtain the required film thickness (90 mils, min.).

The inside surfaces of sub-drainage outlets (weep tubes) shall be coated with hot PVC waterproofing to a depth of at least 1 inch. Immediately after placement of the waterproofing material, 5-inch square pieces of wire mesh shall be pressed into the wet coat of PVC over each sub-drainage opening.

The completed coat of waterproofing shall be free of large pinholes, craters and other placement defects. Pinholes and craters of 1/8 inch diameter and greater shall be corrected by "touching" up with hot PVC material or sealing with pre-cured pieces of PVC waterproofing. Pre-cured patch material is made by applying hot liquid PVC to a smooth, impervious surface (the lid or top of the PVC container is suitable) and allowing it to cure in a sheet form. Pieces of this sticky sheet may then be used to plug holes or patch the PVC membrane. Defects in the waterproofing of less than 1/8" diameter are self-sealing and shall not require repair.

Throughout the duration of work the Contractor shall protect all exposed areas of curbs, sidewalks, railings and other bridge appurtenances. Any damage or defacement resulting from the application of the PVC waterproofing shall be repaired to the satisfaction of the Engineer, at no cost to the State.

D. Application of Protective Sheet:

The protective sheet (65 lb. roofing paper) shall be placed over the PVC polymer waterproofing immediately after completion of the liquid waterproofing application, or a portion thereof, as directed by the Engineer.

The 65-lb. roofing paper shall be placed over all of the structural slab surface, except that it shall not be placed on the vertical faces of curbs, or headers or scuppers. At sub-drainage outlets, holes equal in size to

the outlet opening shall be cut in the roofing paper. The roofing shall not be placed in, or otherwise adhered to the inside surfaces of sub-drainage outlets.

The protective sheet shall be laid flat, without the necessity of adhesives, on the cured surface of PVC waterproofing. (Hot applied liquid PVC polymer waterproofing material will cure to a firm film within several minutes. The surface of the cured PVC will remain in a tacky or sticky condtion. The 65# roofing paper is to be applied directly to the sticky surface.) Rolls or sections of 65-lb. roofing paper shall be set in place by butting against the edges and ends of adjacent sheets. Gaps of up to ¼ inch between sheets are allowable. Overlapping of the protection sheet shall not be allowed.

The completed protection sheet shall be free of wrinkles, "fishmouths," entrapped air bubbles and other defects. Wrinkles and "fishmouths" shall be slit with a knife and laid flat. Entrapped air shall be removed by piercing the roofing paper with an ice pick or other suitable instrument. Care shall be taken not to puncture the underlying PVC membrane.

When the placement defects have been corrected, the entire surface of roofing paper shall be rolled with a 100-200 pound hand roller. If, after rolling, additional air bubbles or other defects are evident they shall be corrected.

Finally, when the placement and rolling of the roofing paper is complete, a bead of hot PVC polymer material shall be run along the intersection where the vertical faces of curbs, headers and scuppers meet the roofing paper. The bead shall be placed such that the void between the roofing paper and applied membrane is filled with polymer to prevent the intrusion of water.

METHOD OF MEASUREMENT:

The work shall be measured as the number of square feet of actual horizontal surface area of the structural slab covered with the complete membrane waterproofing system. No separate measurement of the vertical faces of curbs, headers and scuppers or for the inside surfaces of sub-drainage outlets shall be made.

BASIS OF PAYMENT:

The unit price bid per square foot for this item shall include the cost of furnishing all labor, materials (including wire mesh) and equipment necessary to complete the work.

SPECIAL NOTE:

PROTECTION AND OVERLAYING OF BRIDGE MEMBRANE WATERPROOFING SYSTEM (PVC POLYMER)

The bituminous concrete overlay shall be placed on the structural slab no later than 7 days after the PVC waterproofing membrane system has been applied. On grades, bituminous paving equipment shall be operated in the "downhill" direction to minimize damage to the membrane.

Foot traffic on the exposed PVC waterproofing material shall be minimized to the greatest possible extent. Vehicular traffic shall be prohibited until the bituminous concrete overlay operation has started. Bituminous concrete pavers shall be rubber-tired. Vehicles transporting the overlay material shall be rubber-tired and operated at slow speeds (not to exceed 5 mph.). All vehicles shall avoid making sharp turns, sudden starts and stops or other movements on the membrane that may cause breaks, lifting or other damage. Traffic operation on the membrane shall be at the discretion of the Engineer.

Any damage to the membrane during the overlay operation shall be repaired immediately and prior to the placement of bituminous concrete. Repairs shall be made by placing additional hot liquid PVC waterproofing over the defect at the specified application rate. In lieu of the hot liquid, pre-cured PVC patch material may be used as determined by the Engineer, to repair small defects. Repairs shall extend at least 2 inches in every direction beyond the edge of the defect. Hot liquid PVC patches shall be allowed to cure for several minutes and shall be covered with 65 lb. roofing paper prior to the placement of overlay material. If the protective sheet is wrinkled or torn or otherwise damaged during the overlay operation, it shall be repaired or replaced as ordered by the Engineer.

ITEM-15622.9995 BRIDGE PREFORMED MEMBRANE WATERPROOFING SYSTEM
(ROYSTON BRIDGE MEMBRANE No. 10)

SCOPE:

This work shall consist of furnishing and applying a preformed membrane waterproofing system. It shall include, but not be limited to, the preparation of concrete surfaces; the application of cold applied primer, and preformed membrane as specified in the Contract Documents.

MATERIALS:

The preformed membrane waterproofing system shall be as manufactured by Royston Laboratories, Inc., Pittsburgh, Pennsylvania, and shall consist of the following materials:

Bridge Preformed Membrane - Royston Bridge Membrane No. 10

Primer - Royston Bridge Membrane Primer 713

Mastic Sealer - Royston Roskote A-51 Black Mastic

Wire Mesh for use over subdrainage openings shall be a first class, 1/4-inch mesh by 23 gauge, hot-dipped galvanized cloth.

CONSTRUCTION DETAILS:

A. Preparation of Structural Slab Surfaces.

All structural slab surfaces that are to be waterproofed, including vertical surfaces, shall be prepared and cleaned as follows: Unless otherwise directed by the Engineer, work shall not begin on new structural slabs until a minimum of 28 days after concrete placement.

1. All loose material, including dirt, stones, gravel and concrete laitance shall be removed by vacuuming or blowing with compressed air.

2. Any excess laitance (surface film of concrete), road oil, other bituminous based contaminants, and other foreign materials, including concrete curing compounds, which are detrimental to membrane adhesion shall be removed by sandblasting or wire brushing and washing with water or a combination of these methods. To determine if adhesion problems exist, small test patches of primer and membrane shall be applied to the area(s) in question. These test patches shall then be checked by the Engineer to determine the compatibility and adhesion of the membrane to the concrete surface.

3. All surface projections, including exposed aggregate or any other conditions which have presented so rough a concrete surface, as determined by the Engineer to be detrimental to the membrane,

shall be ground smooth, or grouted smooth with cement mortar or epoxy. If grouting materials are used, they shall be "set up" and surface dry, prior to application of primer. Cement mortar mixes for use in grouting shall be approved by the Engineer prior to use. Epoxy mortar materials shall consist of epoxy material meeting the requirements of Material Specifications 721-01, 721-02 or 721-03, and fine aggregate as approved by the Engineer.

4. Immediately prior to primer application, surfaces to be primed shall be re-cleaned of dust and other loose foreign material by vacuuming or blowing with compressed air.

B. Atmospheric Conditions.

Work shall not be done during wet weather conditions nor, when determined by the Engineer, atmospheric conditions are such as to produce unsatisfactory results. No work shall be done when the structural slab surface temperature is below 50°F and ambient temperatures are below 50°F. The concrete structural slab shall be surface dry at the time of primer application.

C. Primer Application.

After cleaning, all concrete surfaces to be waterproofed shall be primed with Royston Bridge Membrane Primer 713. The primer shall be thoroughly mixed prior to use.

Mixing shall be done by hand only, using clean paddles or other suitable instruments.

The primer shall be applied, without dilution, by the use of brushes or rollers or squeegees or a combination of these methods. Spray application of primer shall not be allowed. The primer shall be applied at an average rate of 90 square feet per gallon and in such a manner as to thoroughly and uniformly cover the concrete surface.

On vertical curb and header surfaces, the primer shall be applied and finished off, in a neat line, to a height that will be one inch ± higher than the upturned edge of the preformed membrane overlay. The entire outside face of scuppers shall be primed. The inside surfaces of subdrainage outlets (weep tubes) shall be primed to a depth of at least 3 inches.

The primer shall be thoroughly dry prior to application of the preformed membrane. Drying time, which is dependent upon temperature and humidity is normally one-half hour. Excess primer, occurring as "puddles" or wet areas, shall be removed by brushes, or as directed by the Engineer.

Primed surfaces which have not been covered with preformed membrane within 24 hours after the application of primer, shall be re-primed.

Primed surfaces which, as determined by the Engineer, have become contaminated by dust and dirt shall be re-primed.

The appearance of bubbles in the primer is normal, due to out-gassing of air and moisture in the concrete. After the primer has dried to a "tack-free" condition, these bubbles shall be broken with squeegees or brooms. Unless otherwise directed by the Engineer, it shall not be necessary to repair the areas where bubbles have been broken.

D. Preformed Membrane Installation.

Royston Bridge Membrane No. 10 shall be applied to primed surfaces no later than 24 hours after primer application.

Rolls of membrane may be applied by hand or mechanical means. The membrane shall be placed on the structural slab sticky side down, by removing the release paper as the work progresses. The preformed membrane shall be turned up the faces of curbs and headers and scuppers to a height equal to the thickness of bituminous overlay. The membrane shall be placed in such a manner as to minimize wrinkles and bubbles but shall not be stretched or otherwise placed in tension. Squeegees shall be used, at the time of application, to smooth the membrane at its point of contact with the structural slab.

To insure adhesion to the structural slab, the preformed membrane shall be hand-rolled with a 100-200 pound roller. Rolling shall be done after placement of the membrane on the structural slab surface or at the end of each day's work, as applicable.

The preformed bridge membrane shall be laid longitudinally on the structural slab in the direction opposite to that of bituminous paving so that end laps are formed in the direction of bituminous paving. It shall be placed from a low to a high area and in such a manner as to produce a "shingling" effect to drain any water that accumulates toward the curb and scuppers. Adjacent rolls of preformed membrane shall overlap a minimum of 2 inches and 8 inches on end laps. The narrow band of release paper which acts as an edge strip shall be removed from an applied roll to expose the sticky edge and to insure bonding with the underside of an adjacent roll and sealing of the lap. End laps shall be sealed by heating the membrane surface to be covered with a propane torch, melting the polyester film and fusing the applied surface to the underside of the covering roll.

The application of preformed membrane shall commence at the curb section(s). The preformed membrane shall be aligned parallel to and be brought up the face of the curb to a height equal to the depth of bituminous overlay. The up-turned portion of membrane shall be bonded to the curb face by the heat fusion method; by heating the sticky side of the membrane with a propane torch and pressing the heated membrane into contact with the curb face. Wrinkles or "fishmouths" or other

membrane defects occurring at the curb face shall be sealed against water intrusion by using mastic sealer (Royston Roskote A-41 Black Mastic) and/or patch strips. Finally, a bead of mastic sealer shall be applied along the entire length of curb face, at the termination edge of the membrane.

The membrane shall be turned up the outside face of headers and scupper frames to the height of the asphalt overlay. The membrane shall be adhered to these surfaces by the heat-fusion method. Any wrinkles and "fishmouths" shall be sealed, using mastic sealer and/or patches. A bead of mastic sealer shall be applied at the termination edge of the membrane.

The termination edge of the membrane at deck ends and expansion joints constructed without headers shall be sealed with mastic sealer.

At subsurface drains, the membrane shall be pierced and the edges turned down and adhered to the inside drain surface by the heat-fusion method. If necessary, mastic sealer shall be applied to insure adhesion of the membrane and to prevent the seepage of water under the membrane. Five-inch square pieces of wire mesh shall be pressed into a coat of mastic sealer, applied over the membrane at each subdrainage opening. Payment for wire mesh shall be included in this item.

When only a portion of the work area is completed in one day, the exposed edge of the membrane shall be sealed with mastic sealer.

The completed membrane shall be free of large wrinkles, "fishmouths," air bubbles and other placement defects. These shall be corrected as directed by and to the satisfaction of the Engineer. When patches are used, the pieces of membrane patch shall be affixed by the heat-fusion method and pressed into contact with the membrane sheet. The patch shall extend at least 4 inches in every direction beyond the edge of the defect. The edges of the patch shall be sealed with mastic sealer. Bubbles of one inch diameter and greater shall be vented by piercing with an ice pick, or other suitable instrument, and expelling the air. Vented bubbles are self-sealing and need not be repaired.

METHOD OF MEASUREMENT:

The work shall be measured as the number of square feet of actual horizontal surface area of the structural slab covered with the complete membrane waterproofing system. No separate measurement for the vertical faces of curbs, headers and scuppers or for the inside surfaces of subdrainage outlets shall be made. No measurement shall be made for laps.

BASIS OF PAYMENT:

The unit price bid per square foot for this item shall include the cost of furnishing all labor, materials (including wire mesh) and equipment necessary to complete the work.

SPECIAL NOTE

PROTECTION AND OVERLAYING OF BRIDGE
PREFORMED MEMBRANE WATERPROOFING SYSTEM

The bituminous concrete overlay shall be placed on the structural deck no later than seven (7) days after the preformed membrane has been applied.

The temperature of the bituminous paving material, at the time of placement, shall not be less than 275°F. nor greater than 310°F.

Foot traffic on the exposed membrane shall be minimized to the greatest possible extent. Vehicular traffic shall be prohibited until the bituminous concrete overlay operation has started. Bituminous concrete pavers shall be rubber-tired. Vehicles transporting the overlay material shall be rubber-tired and operated at slow speeds (not to exceed 5 m.p.h.). All vehicles shall avoid from making sharp turns, sudden starts and stops or other movements on the membrane that may cause breaks, lifting or other damage. Traffic operation on the membrane shall be at the discretion of the Engineer.

Any damage to the membrane during the overlay operation shall be repaired immediately and prior to the placement of bituminous concrete. A quantity of repair material shall be kept on hand against such contingency. No additional payment will be made for any areas that require repairs.

Blisters that may raise during the overlay operation shall be vented to insure adhesion of the overlay to the membrane system. Blistered areas will be most noticeable during the rolling operation. Venting shall be done by inserting an ice pick or other suitable instrument into the affected area. These vent holes need not be repaired.

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ITEM 15622.9996 BRIDGE PREFORMED MEMBRANE WATERPROOFING SYSTEM (HEAVY DUTY BITUTHENE)

SCOPE:

The work shall consist of furnishing and applying a preformed membrane waterproofing system. It shall include, but not be limited to the preparation of concrete surfaces; the application of cold applied primer and preformed membrane as specified in the Contract Documents.

MATERIALS:

The preformed membrane waterproofing system shall be as manufactured by W. R. Grace & Company, Cambridge, Massachusetts, and shall consist of the following materials:

Bridge Preformed Membrane - Heavy Duty Bituthene

Primer - Bituthene Primer

Mastic Sealer - Bituthene Mastic

Wire mesh, for use over subdrainage openings, shall be a first class, 1/4-inch mesh by 23 gauge, hot-dipped galvanized cloth.

CONSTRUCTION DETAILS:

A. Preparation of Structural Slab Surfaces.

All structural slab surfaces that are to be waterproofed, including vertical surfaces, shall be prepared and cleaned as follows: Unless otherwise directed by the Engineer, work shall not begin on new structural slabs until a minimum of 28 days after concrete placement.

1. All loose material, including dirt, stones, gravel and concrete laitance shall be removed by vacuuming or blowing with compressed air.

2. Any excess laitance (surface film of concrete), road oil, other bituminous based contaminates, and other foreign materials, including concrete curing compounds, which are detrimental to membrane adhesion shall be removed by sandblasting or wire brushing and washing with water or a combination of these methods. To determine if adhesion problems exist, small test patches of primer and membrane, shall be applied to the area(s) in question. These test patches shall then be checked by the Engineer to determine the compatibility and adhesion of the membrane to the concrete surface.

3. All surface projections, including exposed aggregate or any other conditions which have presented so rough a concrete surface, as determined by the Engineer to be detrimental to the membrane, shall be ground smooth, or grouted smooth with cement mortar or epoxy. If grouting materials are used, they shall be "set up" and

surface dry, prior to application of primer. Cement mortar mixes for use in grouting shall be approved by the Engineer prior to use. Epoxy mortar materials shall consist of epoxy material meeting the requirements of Material Specifications 721-01, 721-02 or 721-03, and fine aggregate as approved by the Engineer.

4. Immediately prior to primer application, surfaces to be primed shall be re-cleaned of dust and other loose foreign material by vacuuming or blowing with compressed air.

B. Atmospheric Conditions.

Work shall not be done during wet weather conditions, nor when determined by the Engineer atmospheric conditions are such as to produce unsatisfactory results. No work shall be done when the structural slab surface temperature is below 40°F and ambient temperatures are below 40°F. The concrete structural slab shall be surface dry at the time of primer application.

C. Primer Application.

After cleaning, all concrete surfaces to be waterproofed shall be primed with Bituthene Primer. The primer shall be thoroughly mixed prior to use. Mixing shall be done with mechanical mixers or hand mixed, using clean paddles or other suitable instruments. All settled material shall be thoroughly dispersed.

The primer shall be applied, without dilution, by the use of brushes or rollers or a combination of these methods. Spray application of primer will not be allowed. The primer shall be applied at the rate of 200-400 square feet per gallon so as to thoroughly and uniformly cover the concrete surface. Areas of concrete which are porous, and appear dry, shall be given a second coat of primer.

On vertical curb and header surfaces, the primer shall be applied and finished off, in a neat line, to a height that will be one inch ± higher than the height of the completed asphalt overlay. The outside face of metal scuppers shall not be primed. The inside surfaces of subdrainage outlets (weep tubes) shall be primed to a depth of at least 3 inches.

The primer shall be allowed to dry to a "tack-free" condition prior to application of the preformed membrane. This time, which is dependent on temperature and humidity, is normally one hour. Excess primer, occurring as "puddles" or wet areas, shall be removed by brushes, or as directed by the Engineer.

Primed areas which have not been covered with preformed membrane within 36 hours after the application of primer, shall be re-primed.

Primed surfaces which, as determined by the Engineer, have become contaminated by dust and dirt shall be re-primed.

The appearance of bubbles in the primer is normal, due to out-gassing of air and moisture in the concrete. After the primer has dried to a "tack-free" condition, these bubbles shall be broken with squeegees or brooms. Unless otherwise directed by the Engineer, it shall not be necessary to repair the areas where bubbles have been broken.

D. Preformed Membrane Installation.

Heavy-duty bituthene preformed membrane shall be applied to primed surfaces no later than 36 hours after primer application.

Rolls of membrane may be applied by hand or mechanical means. The membrane shall be placed on the structural slab sticky side down, by removing the release paper as the work progresses. Preformed membrane flashing strips shall be placed and turned up the faces of curbs and headers and scuppers to a height equal to the thickness of bituminous overlay. Rolls of membrane shall be placed in such a manner as to minimize wrinkles and bubbles, but shall not be stretched or otherwise placed in tension. Squeegees shall be used, at the time of application, to smooth the membrane at its point of contact with the structural slab.

To insure adhesion to the structural slab, the preformed membrane shall be rolled with a pneumatic tired roller. Rolling shall be done at the end of each day's work, as applicable.

The preformed bridge membrane shall be laid longitudinally on the structural slab in the direction opposite to that of bituminous paving so that end laps are formed in the direction of bituminous paving. It shall be placed from a low to a high area and in such a manner as to produce a "shingling" effect to drain any water that accumulates toward the curb and scuppers. Adjacent rolls of membrane shall overlap a minimum of 2-1/2 inches and 8 inches on end laps. Laps which have not been thoroughly sealed by rolling operations shall be sealed with Bituthene Mastic Sealer.

The application of preformed membrane shall commence at the curb section(s). First, "flashing" strips, cut from rolls of preformed membrane, shall be applied on the curb face to a height equal to the depth of bituminous overlay. The strips shall extend a minimum of 6 inches on the structural slab and shall be thoroughly pressed into contact with the concrete surfaces.

On granite or other rough curb faces, beads of Bituthene Mastic shall be applied to the vertical face, to insure bonding of the flashing strips. The first full roll of preformed membrane sheet

shall then be aligned parallel to and applied on the structural slab as close as possible to the curb face. Wrinkles, "fishmouths" or other membrane defects occurring at the curb face shall be sealed against water intrusion by using Bituthene Mastic and/or patch strips. Finally, a bead of mastic sealer shall be applied along the entire length of curb face, at the termination edge of the membrane flashing strip.

Flashing strips of membrane shall be applied to the outside faces of headers and scuppers. The strips shall be placed on the vertical faces to the height of the asphalt overlay, and shall extend a minimum of 6 inches on the structural slab. The strips shall be pressed into contact with the vertical surface. If necessary, mastic sealer shall be used to insure adhesion. The preformed membrane sheet shall then be applied on the structural slab as close as possible to the vertical face. Any wrinkles, "fish-mouths" or other defects shall be corrected using mastic sealer and/or patches. A beam of mastic sealer shall be applied to the vertical face at the termination edge of the membrane flashing strip.

The termination edge of the membrane at deck ends and expansion joints constructed without headers shall be sealed with mastic sealer.

At subsurface drains, pieces of membrane flashing strip shall be applied to that area of structural slab within 6 inches of the drain opening. The full preformed membrane shall then be placed over the strips to provide double cover. At the subsurface drain, the pre-formed membrane shall be pierced and the edges turned down and adhered to the inside drain surface. If necessary, mastic sealer shall be used to insure adhesion of the membrane and to prevent the seepage of water under the membrane. Five-inch square pieces of wire mesh shall be pressed into a coat of mastic sealer, applied over the membrane at each subdrainage opening. Payment for wire mesh shall be included in this item.

When only a portion of the work area is completed in one day, the exposed edge of the membrane shall be sealed with mastic sealer.

The completed membrane shall be free of large wrinkles, "fish-mouths," air bubbles and other placement defects. These shall be corrected as directed by and to the satisfaction of the Engineer. When patches are used, the pieces of membrane patch shall be pressed into contact with the membrane sheet. The patch shall extend at least 4 inches in every direction beyond the edge of the defect. The edges of the patch shall be sealed with mastic sealer. Bubbles of one-inch diameter and greater shall be vented by piercing with an ice pick, or other suitable instrument, and expelling the air. Vented bubbles are self-sealing and need not be repaired.

METHOD OF MEASUREMENT:

The work shall be measured as the number of square feet of actual horizontal surface area of the structural slab covered with the complete membrane waterproofing system. No separate measurement of the vertical faces of curbs, headers and scuppers, or for the inside surfaces of subdrainage outlets, shall be made. No measurement shall be made for laps.

BASIS OF PAYMENT:

The unit price bid per square foot for this item, shall include the cost of furnishing all labor, materials (including wire mesh) and equipment necessary to complete the work.

ITEM 5622.9997 BRIDGE PREFORMED MEMBRANE WATERPROOFING SYSTEM (PROTECTO WRAP M-400)

SCOPE:

This work shall consist of furnishing and applying a preformed membrane waterproofing system. It shall include, but not be limited to, the preparation of concrete surfaces; the application of cold applied primer, preformed membrane, and protective sheet as specified in the Contract Document.

MATERIALS:

The preformed membrane waterproofing system shall be as manufactured by Protecto Wrap Company, Denver, Colorado, and shall consist of the following materials:

Bridge Preformed Membrane - Protecto Wrap M-400 Membrane

Primer - Protecto Wrap No. 80 AP Primer

Mastic Sealer - Protecto Wrap CA-104 Mastic

Protective Sheet - Protecto Wrap P-100 Protection Sheet

Wire Mesh for use over subdrainage openings, shall be a first class, 1/4-inch mesh by 23 gauge, hot-dipped galvanized cloth.

CONSTRUCTION DETAILS:

A. Preparation of Structural Slab Surfaces.

All structural slab surfaces that are to be waterproofed, including vertical surfaces, shall be prepared and cleaned as follows: Unless otherwise directed by the Engineer, work shall not begin on new structural slabs until a minimum of 28 days after concrete placement.

1. All loose material, including dirt, stones, gravel and concrete laitance shall be removed by vacuuming or blowing with compressed air.

2. Any excess laitance (surface film of concrete), road oil, other bituminous based contaminates, and other foreign materials, including concrete curing compounds, which are detrimental to membrane adhesion shall be removed by sandblasting or wire brushing and washing with water or a combination of these methods. To determine if adhesion problems exist, small test patches of primer and membrane shall be applied to the area(s) in question. These test patches shall then be checked by the Engineer to determine the compatibility and adhesion of the membrane to the concrete surface.

3. All surface projections, including exposed aggregate or any other conditions which have presented so rough a concrete surface, as determined by the Engineer to be detrimental to the membrane, shall be ground smooth, or grouted smooth with cement mortar or epoxy. If grouting materials are used, they shall be "set up" and surface dry, prior to application of primer. Cement mortar mixes for use in grouting shall be approved by the Engineer prior to use. Epoxy mortar materials shall consist of epoxy material meeting the requirements of Material Specifications 721-01, 721-02 or 721-03, and fine aggregate as approved by the Engineer.

4. Immediately prior to primer application, surfaces to be primed shall be re-cleaned of dust and other loose foreign material by vacuuming or blowing with compressed air.

B. Atmospheric Conditions.

Work shall not be done during wet weather conditions nor, when determined by the Engineer atmospheric conditions are such as to produce unsatisfactory results. No work shall be done when the structural slab surface temperature is below 45°F and ambient temperatures are below 40°F. The concrete structural slab shall be surface dry at the time of primer application.

C. Primer Application.

After cleaning, all concrete surfaces to be waterproofed shall be primed with Protecto Wrap No. 80 AP Primer. The primer shall be thoroughly mixed, prior to use. Mixing shall be done with mechanical mixers or hand mixed, using clean paddles or other suitable instruments. All settled material shall be thoroughly dispersed.

The primer shall be applied, without dilution, by the use of brushes or rollers, or squeegees or a combination of these methods. Spray application of primer will not be allowed. The primer shall be applied at such a rate as to thoroughly and uniformly cover the concrete surface. Normal application rate of primer is 110 sq-ft/gal, but depending on the porosity and texture of the concrete surface, the application rate may vary from 80 to 150 sq-ft/gal.

On vertical curb and header surfaces, the primer shall be applied and finished off, in a neat line, to a height that will be one inch ± higher than the top of the upturned edge of the preformed membrane overlay. The entire outside face of scuppers shall be primed. The inside surfaces of subdrainage outlets (weep tubes) shall be primed to a depth of at least 3 inches.

The primer shall be allowed to dry to a "tack-free" condition, prior to application of the preformed membrane. This time, which is dependent upon temperature and humidity, is normally 1/2 to 1-1/2 hours. Excess primer, occurring as "puddles" or wet areas, shall be removed by brushes, or as directed by the Engineer.

Primed surfaces which have not been covered with preformed membrane within 24 hours after the application of primer shall be re-primed.

Primed surfaces which, as determined by the Engineer, have become contaminated by dust and dirt shall be re-primed.

The appearance of bubbles in the primer is normal, due to out-gassing of air and moisture in the concrete. After the primer has dried to a "tack-free" condition, these bubbles shall be broken with squeegees or brooms. Unless otherwise directed by the Engineer, it shall not be necessary to repair the areas where bubbles have been broken.

D. Preformed Membrane Installation.

Protecto Wrap M-400 Membrane shall be applied to primed surfaces no later than 24 hours after primer application.

Rolls of preformed membrane may be applied by hand or mechanical means. The membrane shall be placed on the structural slab, sticky side down, and shall be turned up the faces of curbs and headers and scuppers to a height equal to the thickness of bituminous overlay. To minimize wrinkles and bubbles, rolls of membrane shall be "stretched" into place and squeegees shall be used, at the time of application, to smooth the membrane at its point of contact with the structural slab.

To minimize damage from foot traffic and rolling operations, the polyethylene release film, except for the perforated edge strip, shall remain in place until just prior to application of the protective sheet. The perforated edge strip of polyethylene film shall be removed at the time of placement and alignment of an adjacent roll of membrane. Spliced rolls of membrane have release film on the bottom (sticky side). Care shall be taken to insure removal of the polyethylene film from the spliced areas at the time of membrane application.

To insure adhesion to the structural slab, the preformed membrane shall be rolled with pneumatic tired roller. Rolling shall be done before application of the protective sheet or at the end of each day's work, as applicable.

The preformed bridge membrane shall be laid longitudinally on the structural slab, in the direction opposite that of bituminous paving, so that end laps are formed in the direction of bituminous paving. It shall be placed from a low to a high area and in such a manner as to produce a "shingling" effect to drain any water that accumulates toward the curb and scuppers. Adjacent rolls of preformed membrane shall overlap a minimum of 2 inches and a minimum of 8 inches on end laps. If dirt or dust has contaminated exposed edges, primer shall be applied to the contaminated areas to seal the overlaps.

The application of preformed membrane shall commence at the curb section(s). The vertical face of the curb shall be coated with Protecto Wrap CA-104 sealer. The mastic sealer shall be applied as a smooth

uniform coat. The preformed membrane shall be aligned parallel to and be brought up the face of the curb to a height equal to the depth of bituminous overlay. The membrane shall be thoroughly pressed into the mastic sealer. Wrinkles or "fishmouths" or other membrane defects occurring at the curb face shall be sealed against water intrusion by the use of additional mastic sealer and/or patch strips. Finally, a bead of mastic sealer shall be applied along the entire length of curb face, at the termination edge of the membrane.

The outside face of headers and scupper frames shall be coated with mastic sealer. The membrane shall be turned up and pressed into the sealer to the height of the asphalt overlay. Any wrinkles and "fishmouths" shall be sealed with additional mastic sealer and/or patches. A bead of mastic sealer shall be applied at the termination edge of the membrane.

The termination edge of the membrane at deck ends and expansion joints constructed without headers shall be sealed with mastic sealer.

At subsurface drains, mastic sealer shall be applied to the area of structural deck slab within 6 inches of the drain and to the inside surfaces of the drain, to a depth of 3 inches. The membrane shall be pierced at the drain and the edges turned down and pressed into the mastic sealer. Five-inch square pieces of wire mesh shall be pressed into a coat of mastic sealer, applied over the membrane at each subdrainage opening, prior to the application of protective sheet. Payment for wire mesh shall be included in this item.

When only a portion of the work area is completed in one day, the exposed edge of the membrane shall be sealed with mastic sealer.

The completed membrane shall be free of large wrinkles, "fishmouths," air bubbles and other placement defects. These shall be corrected as directed by and to the satisfaction of the Engineer. When patches are used, the area shall be coated with mastic sealer and pieces of membrane pressed into the sealer over the defective area. The patches shall extend at least 6 inches in every direction beyond the edge of the defect. Bubbles of one-inch diameter and greater shall be vented by piercing with an ice pick, or other suitable instrument, and expelling the air. Vented bubbles are self-sealing and need not be repaired.

E. Application of Protective Sheet.

Protecto Wrap P-100 Protection Sheet shall be placed over the preformed membrane immediately after completion of the membrane work, or a portion thereof, as directed by the Engineer.

The protective sheet shall be placed over all of the structural slab surface, except that it shall not be placed on the vertical faces of

curbs, or headers or scuppers. At subdrainage outlets, holes equal in size to the outlet opening shall be cut in the protective sheet. The protective sheet shall not be placed in, or otherwise adhered to, the inside surfaces of subdrainage outlets.

The protective sheet shall be placed, without the necessity of adhesives, to dry membrane surfaces (no visible moisture). The polyethylene release film shall first be removed from the surface of the preformed membrane. If polyethylene has been used to separate the protective sheet, it shall be removed. Sections of the protective sheet shall then be set in place by butting against the edges and ends of adjacent sheets. The protective sheet shall be placed in such a manner as to avoid its end and edge joints being coincident with laps in the preformed membrane. Gaps, up to 1/4 inch in the joints and small overlaps of the protection sheet, are allowable.

To insure adhesion to the preformed membrane and to concentrate entrapped air, after placement of the protective sheet, the entire area shall be rolled with a pneumatic tired roller. Entrapped air shall be removed by piercing the protective sheet with an ice pick or other suitable instrument. Care shall be taken not to puncture the underlying membrane. It will not be necessary to patch these vent holes.

Damaged areas or improper butt joints in the protective sheet shall be patched using strips of sheet and primer to insure bond.

METHOD OF MEASUREMENT:

The work shall be measured as the number of square feet of actual horizontal surface area of the structural slab covered with the complete membrane waterproofing system. No separate measurement of the vertical faces of curbs, headers and scuppers or for the inside surfaces of subdrainage outlets shall be made. No measurement shall be made for laps.

BASIS OF PAYMENT:

The unit price bid per square foot for this item shall include the cost of furnishing all labor, materials (including wire mesh) and equipment necessary to complete the work.

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